The NASA Orbiting Carbon Observatory-2 (OCO-2) Mission: A Quick Look Back at the First 3 Years of Operations

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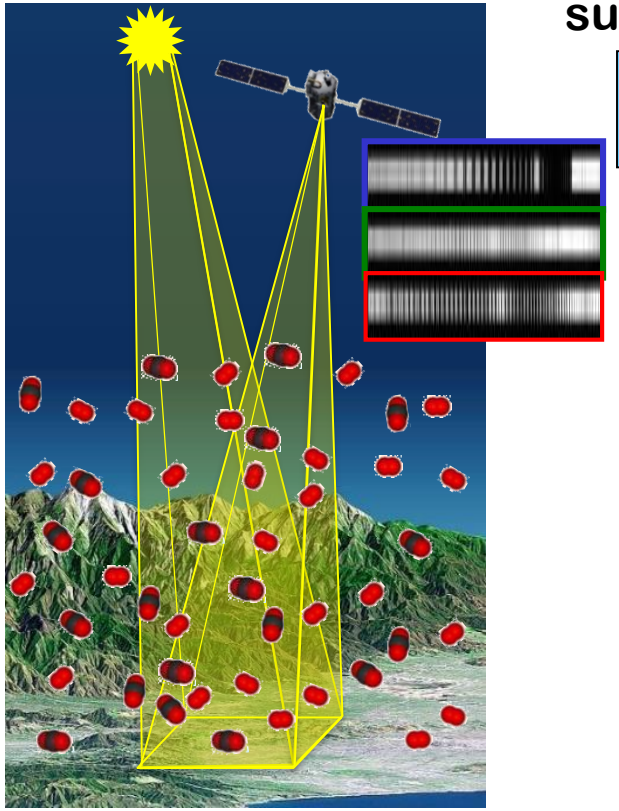
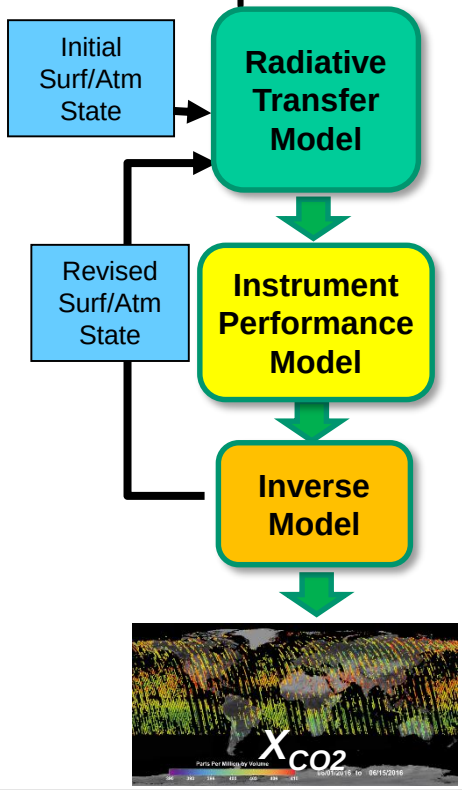
Measuring CO_2 from Space

- **Record** spectra of CO_2 and O_2 absorption in reflected sunlight

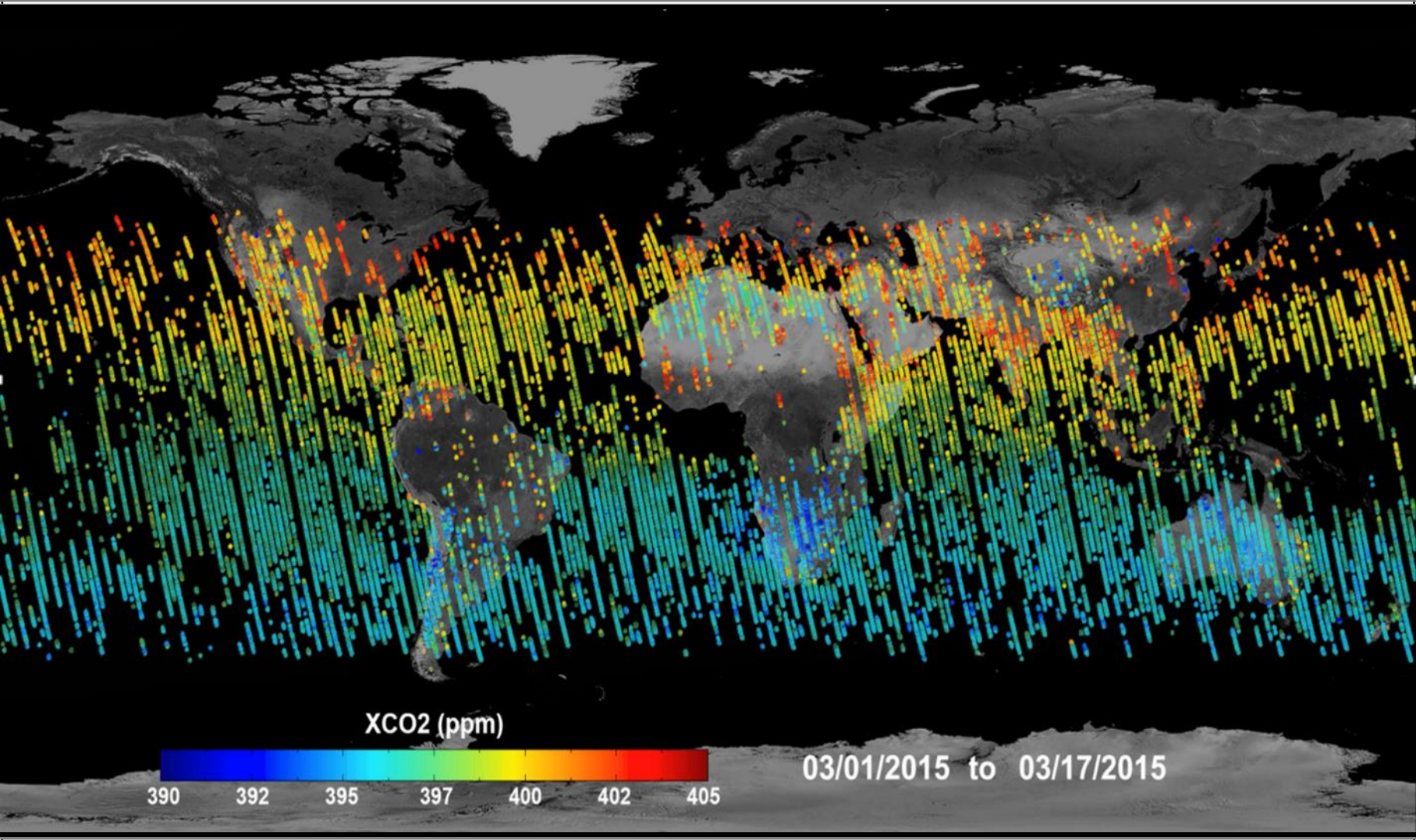
Retrieve variations in the **column averaged CO_2 dry air mole fraction, X_{CO2}** over the sunlit hemisphere

Validate measurements to ensure X_{CO2} accuracy of 1 ppm (0.25%)

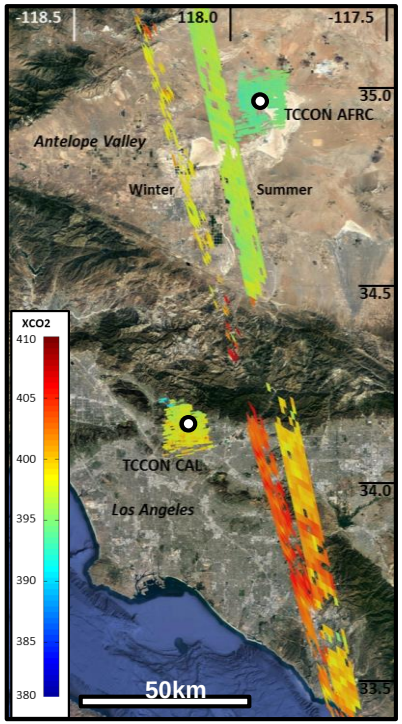


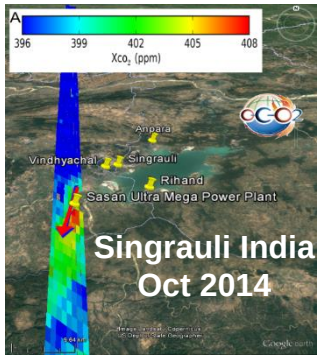


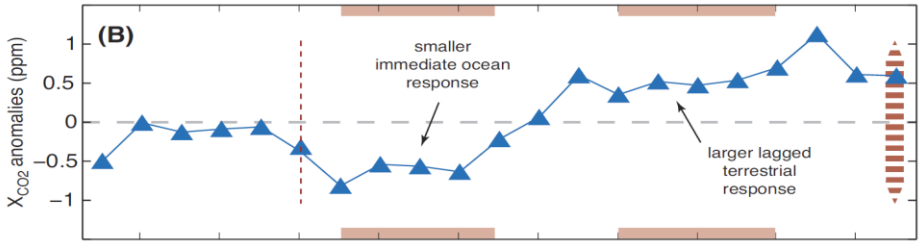
A Quick Look at the OCO-2 Prime Mission

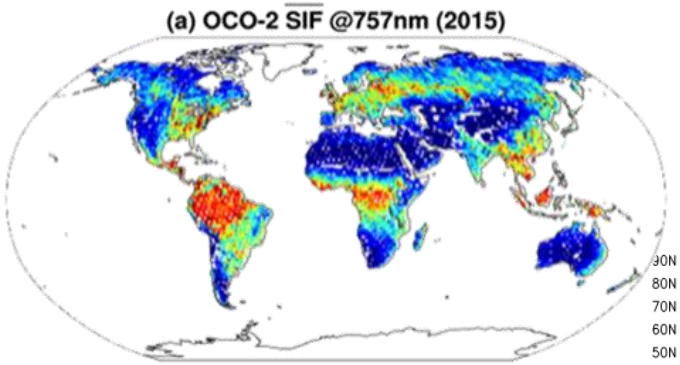


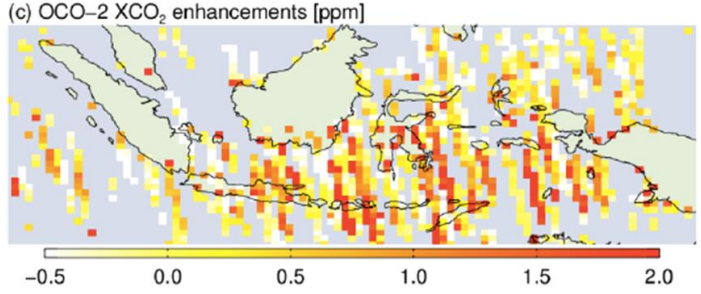
A Quick Look at Science Results



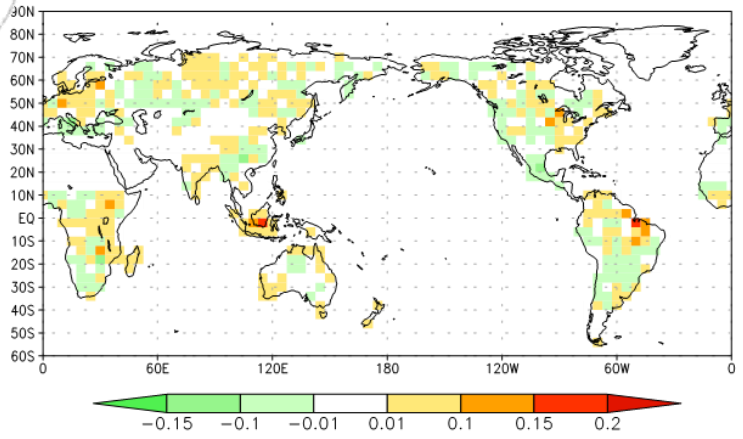


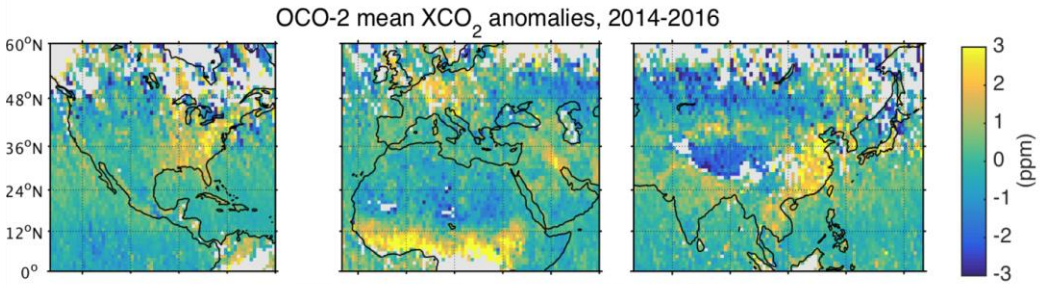






2015 - 2011 (GtC/yr)



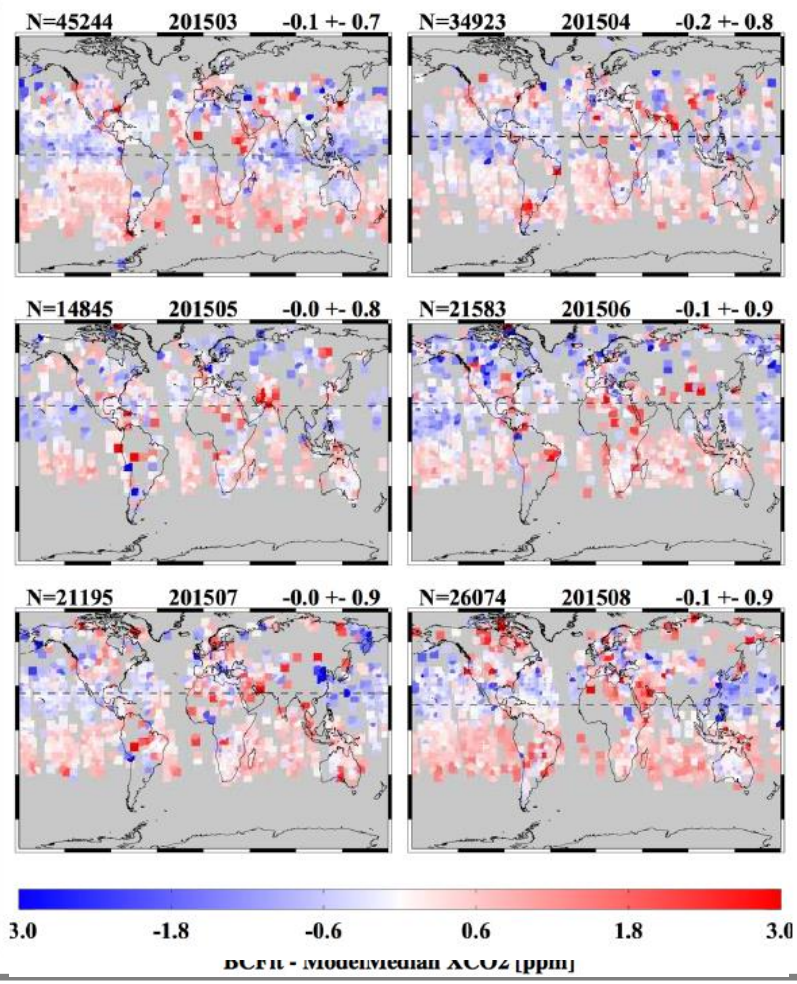


A New OCO-2 Data Product: Build 8 (B8)

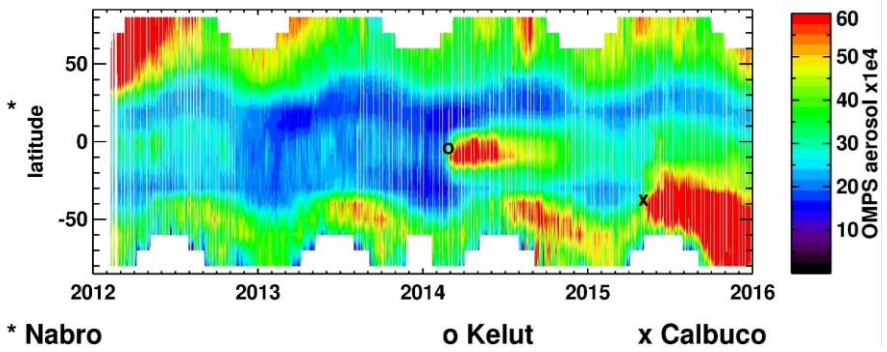
- Improved Calibration
  - Fast (icing) and slow (solar diffuser) degradation corrected
  - Corrected zero level offset A-band detector
- Retrieval algorithm updates
  - Gas absorption cross sections (ABSCO 4.2 vs 5.0)
  - Added an optically-thin, stratospheric aerosol type
  - More realistic land surface reflectance model (soil BRDF)
  - Updated cloud screening, bias correction, and warn levels
  - Other small improvements
    - Changed prior meteorology from ECMWF → GEOS5 (FP-IT)
    - Revised X_{CO2} and Cirrus priors
    - Updated top of atmosphere solar spectrum

Tracking and Correcting Biases

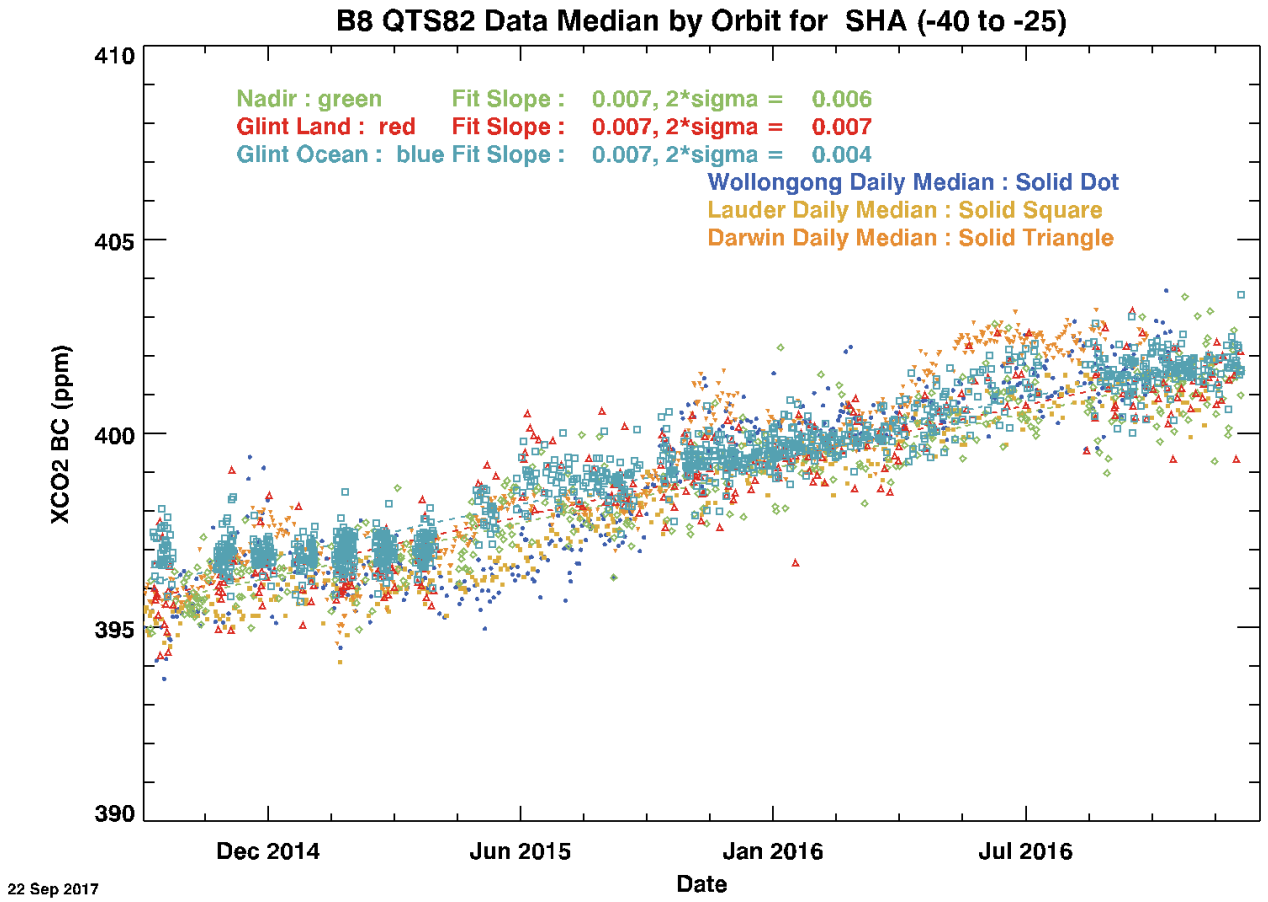
With Strat Aerosols



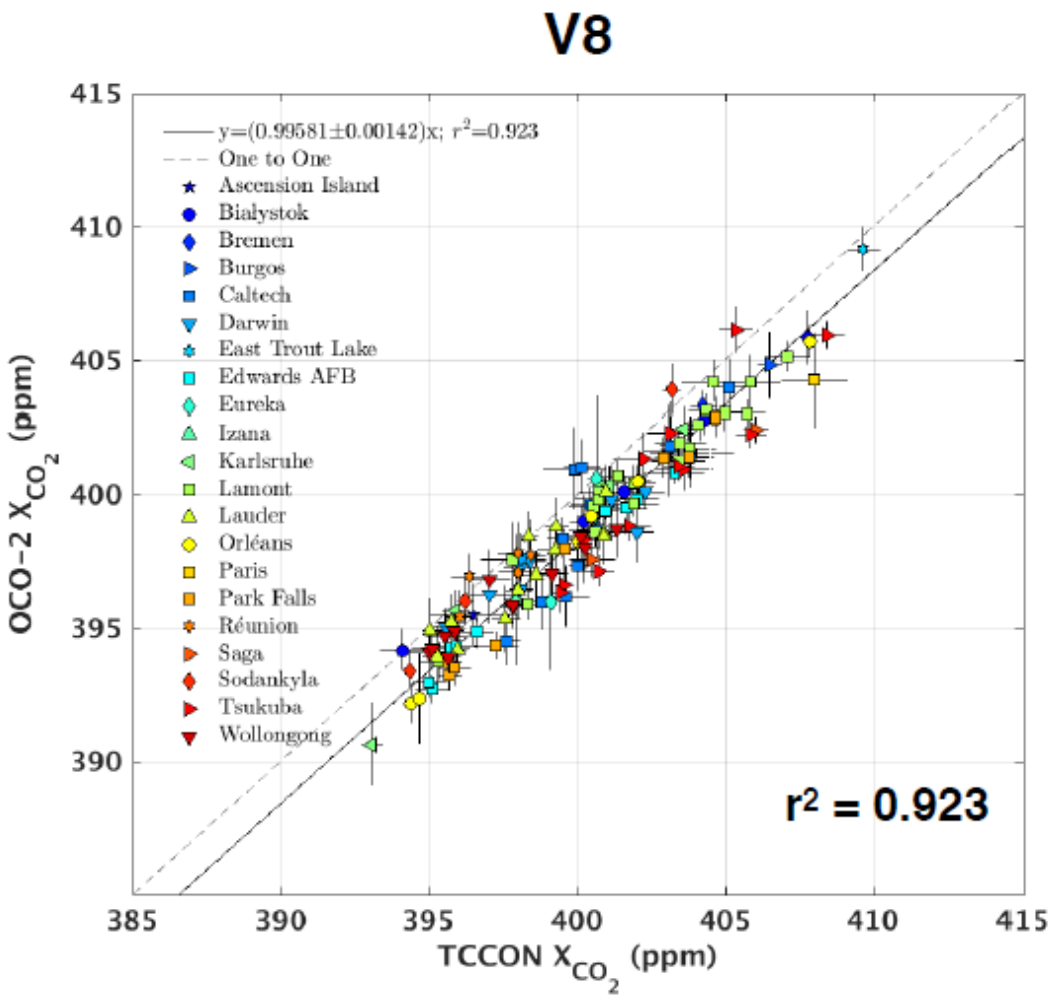
- **High bias seen over southern hemisphere oceans (glint) March-September, relative to models.**
- **Traced to Optically-thin stratospheric aerosol layers**
  - **The largest effects are seen at high latitudes over the ocean during the southern winter months**
  - **Effect was enhanced by volcanic activity (Wolf and Calbuco) which enhanced stratospheric aerosols**



A Preview of the Version 8 Product

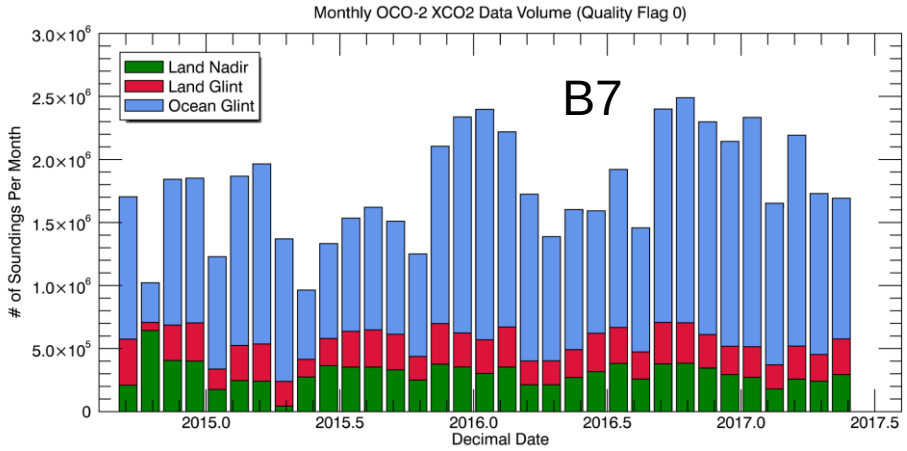


B8 Agrees Better with TCCON



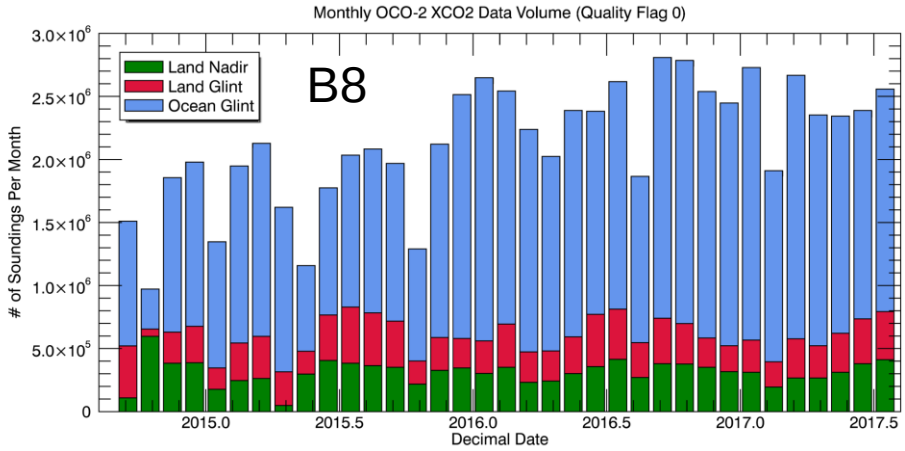
(Kiel et al. 2017)

Improvements in Yield

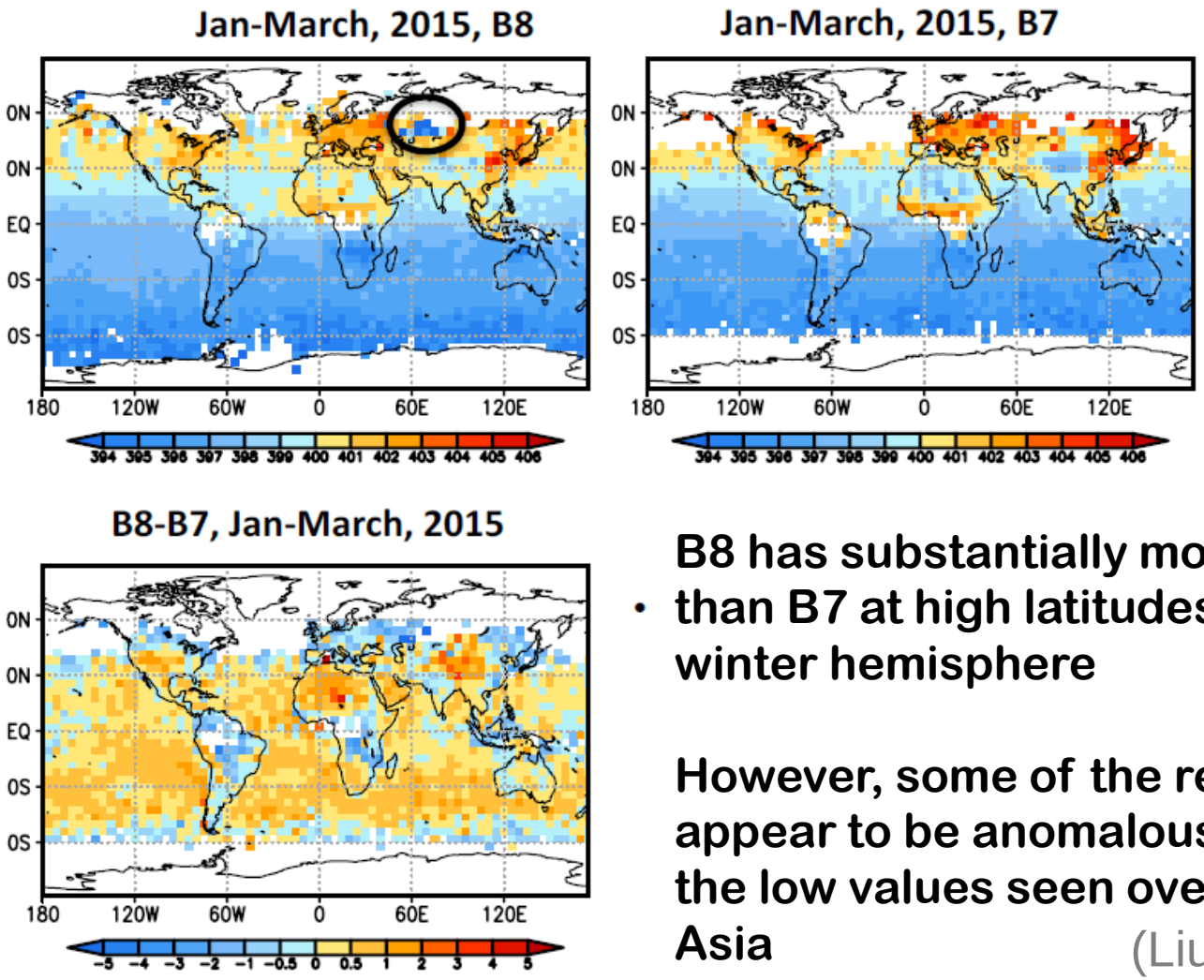


The sounding yield for B7 was ~7% (2 million soundings/month) once the optimal observing scheme was implemented.

Improvements in the cloud screening algorithm and other changes in the L2 algorithm increased the B8 yield to > 8%, with the largest changes seen in the tropics and at at high latitudes



Differences in Coverage between B7 and B8

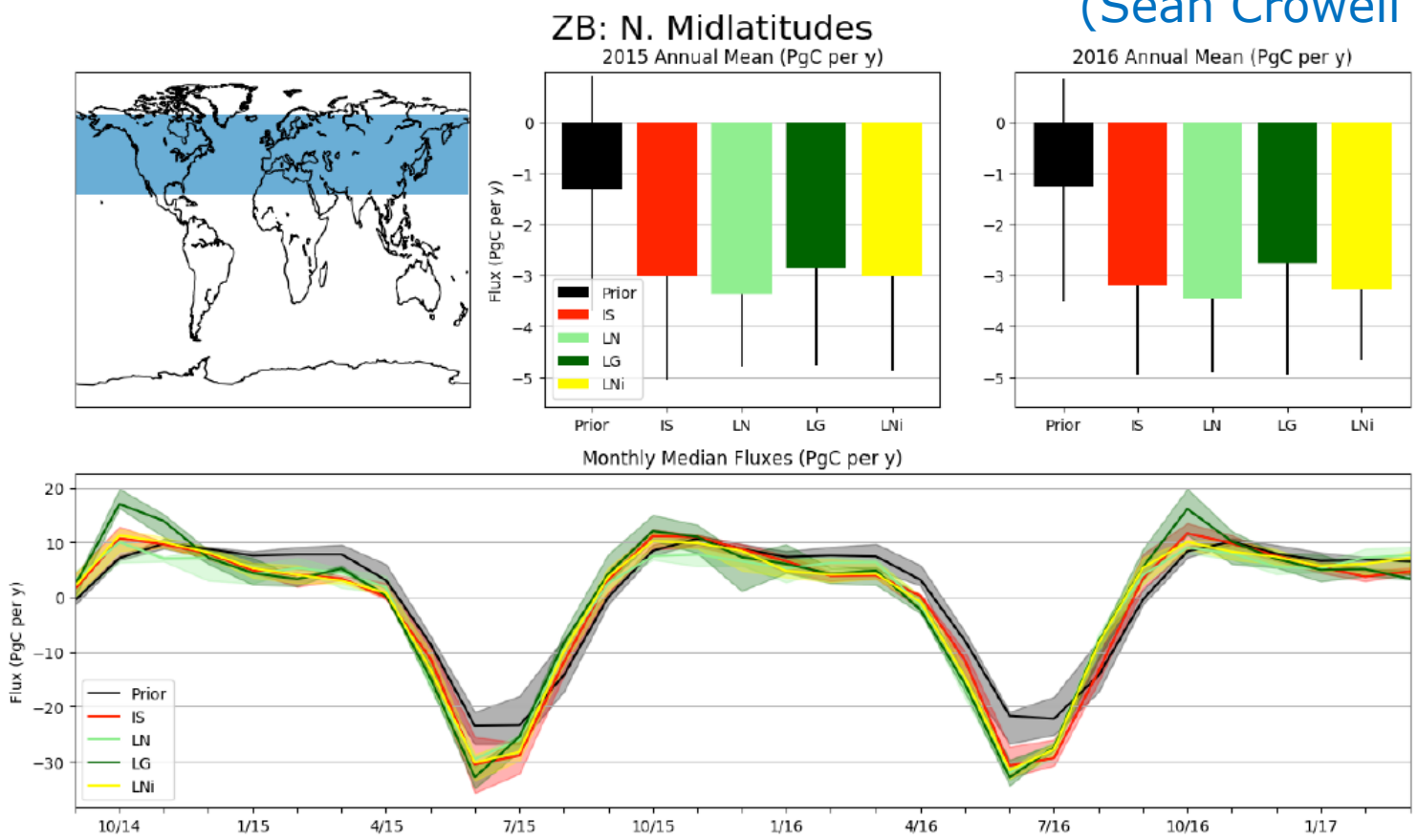


- B8 has substantially more coverage than B7 at high latitudes in the winter hemisphere

However, some of the results appear to be anomalous – such as the low values seen over central Asia (Liu et al. 2017)

Other Coming Attractions: A Flux Inversion Product

(Sean Crowell et al.)



Inversions using OCO-2 X_{CO2} (B7) have a larger seasonal cycle than prior or simulations using only in situ observations. The phase is also shifted earlier.

Summary

- Since September 2014, OCO-2 has been returning 25,000-85,000 full column estimates of X_{CO2} and solar induced chlorophyll fluorescence (SIF) over the sunlit hemisphere each day
- These measurements provide a description of the atmospheric CO_2 distribution with an unprecedented combination of precision, resolution, and coverage
- The OCO-2 data set has been reprocessed with the Build 8 (B8) algorithm, which further improves accuracy and coverage
- The B8 products been delivered to the Goddard Earth Science Data and Information Services Center (GES-DISC) :

https://disc.gsfc.nasa.gov/datasets?page=1&source=OCO-2%20OCO%20SPECTROMETERS

Thank You for Your Attention

Questions?